Allergy to a Hot Tub Water Treatment Chemical

An Unexpectedly Common Cause of Generalized Dermatitis in Men

Patricia Gilligan, BS; Anthony Vander Horst, MA; Matthew J. Zirwas, MD

Introduction: Potassium peroxymonosulfate (PPMS) is a potassium triple salt (2KHSO5 • KHSO4 • K2SO4) that is commonly used as an oxidizing compound in pool and hot tub shock treatments. It is the active ingredient in Oxone® (DuPont), a pool and spa oxidizer. In its disulfate form, PPMS is used in hair-bleaching preparations, flour, and denture cleanser, and has been reported as a cause of contact dermatitis, urticaria, and asthma.[1–5]

DuPont lists "allergic reactions in sensitive individuals" as a potential health hazard of Oxone in its safety information.[6] However, contact dermatitis induced by PPMS used in pools or hot tubs has only been documented in two case reports, both of which involved hot tubs.[1,4]

In August of 2008, the authors began to question all of their patients with widespread dermatitis about the use of hot tubs, and all patients who used hot tubs were tested for allergy to PPMS. Over the ensuing 12 months, the authors diagnosed six patients with allergy to PPMS used as shock treatment in their hot tubs or pools, all of whom were demographically similar (Figure 1).

Objective: The objective of the study was to determine the demographic characteristics of patients diagnosed with allergy to PPMS and determine the likelihood that these characteristics represent a significant finding.

Methods: A retrospective chart review of all patients diagnosed with allergic contact dermatitis due to PPMS used as a shock treatment in hot tubs was performed. Data was extracted on the patients' age and sex, the duration and distribution of dermatitis, the rapidity of flares after exposure, the course after diagnosis and avoidance, history of exposure, and the results of patch testing.

Results: The age and gender, duration and distribution of dermatitis, rapidity of flares after exposure, course after diagnosis and avoidance, history of exposure, and the results of patch testing are shown in Table 1.

The most notable aspect of these patients is that they are all men. If men and women were equally likely to be allergic to PPMS used in hot tubs, we can assume the theoretical probability is that 50 percent of the affected patients should be men. In this assumption, the theoretical probability of exactly eight out of eight patients randomly being men is 1 in 256. This is a highly statistically significant finding (p=0.0039), meaning it is appropriate to reject

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Clinical Contact Dermatitis is a Special Section dedicated to featuring all types of contact dermatitis and providing information on prevention, diagnosis, and treatment of these skin disorders. If you would like to contribute to this section, please contact Matthew Zirwas, MD, at matt.zirwas@osumc.edu.

the theory or hypothesis that men and women are equally likely to be affected by PPMS.

There are several other notable aspects about these patients. First, the age range is relatively small, with patients all being between the ages of 45 and 80. Second, the distribution of dermatitis follows what would be expected. Third, in patients for whom data was available, flares started quickly following exposure, with an increase in itching starting within 6 to 12 hours of exposure. Fourth, hot tubs appear more likely to be problematic than pools. Finally, it appears that testing with ammonium persulfate is an adequate screening test for allergy to PPMS used as a shock chemical, as 7 of 8 patients tested positive with at least a 2+ reaction.

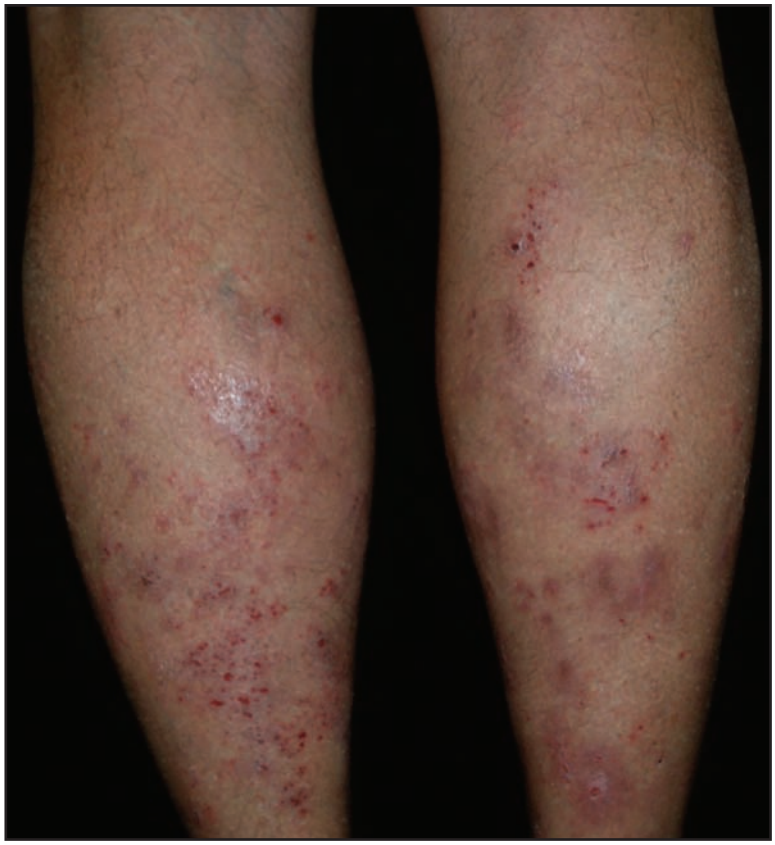

Figure 1. Severe dermatitis on the lower legs in a patient with allergy to potassium peroxymonosulfate who sat with legs "dangling" in the water

Discussion

Allergy to PPMS used as a hot tub shock chemical appears to be much more common than has previously been appreciated. After starting to routinely ask about hot tub use in patients with generalized dermatitis, the authors identified six patients over a period of 12 months, despite there only being two reported cases in the medical literature. The authors suspect that allergy to PPMS has been underdiagnosed, as neither PPMS or ammonium persulfate are typically used when patch testing patients with widespread dermatitis.

Pool and hot tub water treatment consists of a two-step process: (1) sanitation and (2) oxidation ("shocking"). Sanitation is the process by which pathogenic micro-organisms are killed, and is typically accomplished by a chlorine or bromine donor added to the water. Oxidation is the process by which organic contaminants, such as perspiration, body oils, and cosmetic products, as well as material introduced to the water from the outdoors, are eliminated. Oxidation also removes chloramines/bromamines, which are irritating compounds produced when chlorine/bromine reacts with organic contaminants in the pool water. In pools and hot tubs in which sodium bromide or bromine tablets (BCDHM) are used for sanitation, PPMS also acts to activate the bromine sanitizer. Shocking with PPMS is recommended weekly for pools and with every use for hot tubs.

The authors strongly recommend that all patients with generalized dermatitis be asked about hot tub and swimming pool use. It is even more important to ask about hot tub and swimming pool use if the patient is a man between the ages of 45 and 80, as this is the demographic at highest risk. If the patient reports using a hot tub, then patch testing with ammonium persulfate (APS), which is available from all major allergen suppliers, should be undertaken. If patch testing is positive, then the patient should be instructed to avoid exposure to hot tubs and swimming pools treated with PPMS-based shock treatments. Alternatives are to use hyperchlorination-based shock treatment or hydrogen-peroxide-based shock treatment, or to drain and refill the hot tub periodically instead of shocking it.

If patch testing with APS is not

TABLE 1. Characteristics of reported patients with allergy to PPMS used as a shock treatment in hot tubs

PATIENT	AGE	GENDER	DURATION	DERMATITIS WIDESPREAD?	IMPROVED WITH AVOIDANCE?	HISTORY OF EXPOSURE TO PPMS OR APS?	PPMS PATCH TEST RESULT	APS PATCH TEST RESULT	EXPOSURE SOURCE
1	59	M	4–5 years	Axillae, abdomen, thighs, flanks, ankles	Yes	No	1+	2+	Hot tub
2	53	M	1 year	Legs, trunk, arms	Yes	No	1+	2+	Hot tub
3	60	M	4 months	Axillae, flanks, thighs, calves	Yes	No	1+	2+	Hot tub
4	49	M	15 months	Calves, thighs, chest, abdomen	Yes	No	1+	2+	Hot tub
5	54	M	14 months	Back, thighs, axillae	Yes	No	1+	2+	Hot tub
6	77	M	1 year	Face, chest, arms, legs	Yes	No	Not done	2–3+	Swimming pool
7	55	M	1 year	Anterior legs, thighs, torso	Yes	No	1+	Negative	Hot tub
8	45	M	1 year	Trunk, extremities	Yes	Unknown	Not done	2+	Hot tub

available, then the patient should be instructed to completely avoid hot tub and swimming pool exposure for a period of at least two months. If their dermatitis improves, then they should either continue to avoid PPMS by using one of the methods noted above or they could confirm the allergy by challenging themselves with re-exposure to PPMS and observing for a flare of their dermatitis.

The authors do not have an explanation for why men are more likely to be affected. Perhaps they spend more time in hot tubs or are more likely to handle the chemicals as part of maintaining hot tubs. Or perhaps there is an unexpected explanation that is yet to be discovered.

Conclusion

In summary, allergy to PPMS used in hot tubs and swimming pools appears to be much more common than previously known. Patients with the highest risk are men between the ages of 45 and 80. This is a relatively easily identifiable cause of widespread, recalcitrant, severe dermatitis, and all patients presenting with this picture should be questioned about hot tub use.

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